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ABSTRACT

The status of high school students' mathematics and science preparation and the existence of gender inequities in such courses were investigated in this study of Rhode Island secondary schools. A stratefied random sampling of districts was taken to include schools demographically representative of the state's population. Course enrollment data from the senior classes of 1985 were used (N=1111). The data were analyzed to determine: (1) the number of females and males who had enrolled in each mathematics and science course; (2) the percentage of each gender enrolled in these courses; and (3) the average grades received by males and by females in the mathematics and science courses. Survey results indicated that the 1985 female and male graduates took similar numbers and types of mathematics and science courses. Female enrollment in both upper level mathematics courses and in science courses, except in General Science and Physics, was either equal to or greater than male enrollment. In addition to choosing as many high level courses as their male classmates, young women in the sample tended to receive higher grades than their male counterparts. Brief case studies of the six schools surveyed and analyses of their data are also included. Appended are tables showing mathematics and science courses taken in high school by the class of 1985 and mathematics and science grades received by students at six Rhode Island high schools. (ML)

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MATH AND SCIENCE EDUCATION IN HIGH SCHOOLS: A QUESTION OF SEX EQUITY?

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MATH AND SCIENCE EDUCATION IN HIGH SCHOOLS: A QUESTION OF SEX EQUITY?

Introduction

Much national attention has focused on the courses offered to and chosen by the high school students of the 1980's. The concern stems primarily from two sources: the major reports which have dominated discussion of educational reform, and the drive to achieve sex equity in schools and education.

The reform reports stress the need for better articulated curricula in order to prepare students to meet the needs of this and the coming decades. While emphasizing the benefits of a strong liberal arts background, the reports have also sparked a concern for math and science education. For example, the National Commission on Excellence in Education (1983) report opens with:

> Our nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world.

One effect has been the proliferation across the states of various basic education plans with their increased minimum requirements for achieving a high school diploma.

The other source of concern about course offerings and choices originates with Title IX, now a decade old. Title IX addresses areas such as the numbers of boys and girls enrolled in certain classes as well as the subtle practices influencing decisions to enroll. One specific area for concern has been the inequity in math and science preparation of females compared to males. Extensive research conducted in the United States during

the past decade (Armstrong, 1980; Carpenter, et al 1981; Fennema and Sherman, 1977; Fox, Brody, and Tobin, 1980; Reis, 1980; Sherman, 1978) has revealed that females are not as prepared in math and science as their male counterparts. For example, the startling results of one study (Sells, 1978) reported that, of freshmen entering the University of California at Berkeley in 1972, 57% of the males had taken four years of high school math, but only eight percent of the females had taken the same amount. Without four years of high school math, 92% of these young women were ineligible for ten out of the twelve colleges at Berkeley and twenty-two out of the forty-four majors. Thus, their options were foreclosed, even before these young women entered college.

The question of how prepared high school students are today in math and science links the equity issues with the reform concerns. James Rutherford, chief officer of the American Association for Advancement of Science, observed that "science and technology are driving our culture." Thus, not only is it important that women possess the math ability and technical skills to enter the higher paying jobs previously dominated by males, but it is also essential that the nation's women, who constitute 43% of the workforce, contribute to its technological needs. In other words, all students must be offered equal choices and encouragement for preparation.

In response to these issues, we became interested in determining both the level of math and science preparation of public high school students in our state, Rhode Island, and the existence of any gender inequities in math and science course

selection. Some local activities offered incentive to collect this data. First, the Education Committee of the Governor's Advisory Commission on Women had identified the promotion of sex equity in math and science as a priority for the 1984-85 year. The Committee proposed workshops on the subject for public school principals and math and science teachers. To the Committee's surprise, the high school people they approached rejected the idea based upon their perception that females take at least as many math and science courses and do as well as males. Second, the state began its first year of implementing a basic education plan and a new structure of requirements for receiving a high school diploma. The new plan imposes, for example, a minimum of three years of college prep math for a college-bound diploma.

As researchers who often work with practitioners, we saw a need to describe the current reality of math and science enrollment. The state had no composite figures; even the national studies were dated. Perhaps female enrollments in math and science have increased to equal males. While there is much talk about inequity, the responses of public school administrators indicated that the public doubted, or was at least not aware, that any serious problem existed. We thought that a study on course enrollments could draw attention to existing problem areas or could alert educators to the possibility of new trends. We also suspected that some baseline data collected before the new requirements took effect might prove useful in the future. To satisfy what we saw as a need, then, we designed and conducted this study.

The Study

In the fall of 1984 we contacted various state Department of Education officials to ascertain if any similar data had previously been compiled. Apparently, none existed at either the state or local levels. We established an advisory committee consisting of guidance counselors, principals, and state Department of Education people to help us select a sample of public high schools in the state from which to collect the data and to design the survey.

First, we decided to collect course enrollment data from current seniors, that is, the class of 1985. This decision seemed most practical in that schools in the state file data of graduates for all classes alphabetically; thus, sampling "graduates" would draw from all previous classes, covering too broad a span of years. Second, we decided to sample by school rather than draw sample students from a greater number of schools. We chose this approach because we wanted to see if any differences that might surface were due to geography or socio-economic status of the community. Furthermore, we felt that producing "pictures" of representative schools would give a more accurate picture of the state as a whole than would a random sampling of students throughout the state.

A stratified random sampling of districts was selected to include schools which were demographically representative of the state's population. The school districts surveyed include a large city, a small city, a largely upper middle-class suburb, a partially rural district, and a vocational/technical high school.

The districts comprise 12% of the state's student population and the seniors of these high schools (n= 1111: 556 males and 555 females) made up 11% of the state's 1985 fall enrollment of seniors (9993). In sum, we were sure that the data we could draw from these schools would offer us an accurate profile of Rhode Island's public school population.

Data collection required reviewing the file of every senior enrolled in the sample schools in order to insure accurate documentation of enrollments. To facilitate collection and subsequent analyses, we desiged a form to record all math and science courses taken and grades received by, as well as sex of, each senior student in the sample schools. Course titles for the form were determined by obtaining course titles and descriptions for each of the sample schools. Thus, we included all courses, and courses with different titles but similar content were collapsed into a title which could be readily recognized. For example, Trigonometry was incorporated into Advanced Math because it was listed as a separate course at only two of the six schools while at the other four it was included in Advanced Math. The form also recorded other data, such as SAT scores, that we intended to use in our analyses.

Superintendents were contacted for official approval, and we met with guidance personnal in the individual high schools to make arrangements for data collectin. We needed to work closely with senior guidance counselors both because their information on the schools and senior classes would be essential to our interpretation of results and because, since student files are

confidential, our access was justifiably limited. In two of the schools, everyone we dealt with, from the superintendent down, was cooperative and interested. In these schools, the counselors themselves read the information directly to us from the files. They commented on how informative the process was to them, and they offered various explanations for particular patterns that appeared. Two of the other schools were uninterested and indifferent, allowing us to search the files for what we wanted, once they were assured that we did not want personal information about students. The big city system with two schools was openly resistant at first, not because of the issue of informed consent access to school records, but because of the "unnecessary and frivolous" nature of the research. They appeared defensive about the possibility of being compared with other districts. Once they understood our intent, and when we agreed to provide further technical assistance to the assistant superintendent, we received total cooperation.

When the forms were completed, the data were key-punched and analyses were conducted to determine the following:

- the numbers of females and males who had enrolled in each math and science course
- the percentages of each gender enrolled in those courses and of the students in each course by gender
- the average grades received by males and by females in these math and science courses

We chose not to analyze other data such as SAT scores since this information was not available in a consistent manner across schools. The data from each school were analyzed separately and in aggregate.

We are currently involved in a second phase of this study. The state's Department of Education Title IX Office has funded us in 1986 to interview counselors and to survey current seniors in as many schools as possible in the state for the following purposes:

- to corroborate results on course enrollments gathered during the first phase
- to identify student career choices and post-graduation plans
- to gather students' perceptions of why they have made particular choices concerning course selection, careers, and post-graduation plans
- to increase awareness of possible gender influences on choices

The survey being used in this phase of the study is a self-report questionnaire asking students to check titles of math and science courses taken, post-graduation plans, major choices for college-bound students, career choices, and possible factors or persons who may have influenced these decisions. To date, we have completed and run preliminary analyses on these questionnaires for seven schools, three of which were also in the study reported in this paper.

Results

Young men and young women graduating from Rhode Island's public high schools in 1985 took similar amounts and types of math and science. More males than females enrolled in the general math and pre-algebra courses, but female enrollment was greater than male enrollment in the pre-college sequence of Algebra I, Geometry and Algebra II. Female enrollment in upper

level courses was strong; specifically, Advanced Math drew 114 females to 100 males; in Calculus, 28 females and 29 males enrolled.

Similarly, female enrollment was equal to or greater than male enrollment in all science courses except General Science and Physics. Chemistry drew noticeably more females than males (213 females to 161 males), a trend continued in Chemistry II (23 females to 17 males). While more males enrolled in computer courses than females, the differences were minimal. The complete data are compiled in the Appendix where Tables 1 and 2 display the number of students who enrolled in each course as well as the percentage of students in the course who were of each gender and the percentage of the total number of each gender included in the study who took the course. The sample included nearly equal numbers of males (556) and females (555). We did not conduct statistical tests to determine the significance of differences in enrollment because once we determined that the numbers and types of courses chosen by females were not less than those chosen by males we saw no point in demonstrating differences.

In addition to choosing as many high-level courses as their male classmates, young women in the sample tended to receive higher grades for their work in math and science classes than their male counterparts. Sixty percent (60%) or 460 of all A's awarded in math and science classes were earned by females compared with 40% or 305 earned by males. Female students also received more B's awarded in math and science classes (52%, that is, 1066) while young men received 48% (972). Male students received C's more frequently than their female classmates.

Fifty-four percent (54%) or 1447 of the C's were given to males, while 46% or 1220 of the C's went to females. The mean of grades received by males in math and science courses is 2.36; the mean of math and science grades received by females is 2.51. The difference between these two figures is statistically significant (p= .004).

We were struck by how few students took beyond a minimum of math and science courses. Only 20% of the seniors in the sample took eight or more math and science courses. Fifty-six percent (56%) enrolled in at least six courses of math and science. Only these students would be eligible to graduate under the new requirements for students planning to attend a four-year academic post-secondary institution. (Under the new requirements, the mathematics must be college preparatory and the sciences must be laboratory sciences; this particular analysis did not differentiate between college prep courses and general, so the 56% includes many non-college prep courses as general math and businesss math.) Sixteen percent (16%) of those who graduated in the class of 1985 would not have met the new minimum of two years of math and two years of science required for a general diploma.

While the patterns in each school are similar, we believe that the aggregate results are strengthened by the results from the separate schools. The following brief case studies describe each school and its results.

School A

School A is located in a small suburban town which has a somewhat rural character because of several large farms. The

community's residents are largely middle-class and culturally homogeneous. The class of 1985 consisted of 183 students, of which 85 (46%) were males and 98 (54%) were females.

According to the Director of Guidance at School A, many town residents send their sons and daughters to private schools. Most students at School A are encouraged by their parents to view themselves as college-bound. The counselors relate that most young women who go to college after graduating from School A attend in-state schools, while many more young men leave the state for college.

Even taking into account the male/female ratio of the entire senior class, females at School A took at least as much high-level math and science courses as did males. For example, Calculus was 55% female, 45% male. In Advanced Math twice as many females (14) as males (7) enrolled. While more young men (14) than young women (6) took Physics, more young women (15) than young men (7) enrolled in Human Physiology (an advanced biology class). The Chemistry II class was evenly divided with six females and six males enrolled.

Young women at School A also received higher grades for their work in math and science courses than their male classmates. Females received 60% (95) of the A's given in math and science classes, while males received 40% (64). Young women obtained B's more frequently than young men, 54% (235) to 46% (197) of the total. Females received slightly more (52%, 211) C's than males (48%, 192). Young men received failing grades in 34 (63%) instances, whereas young women received only 20 (37%) failing grades.

School B is the high school in a small city populated primarily by working-class low income families. The population of this city is ethnically and culturally diverse. The city's residents include many recent immigrants. School B's class of 1985 consisted of 136 students, 63 (46%) males and 73 (54%) females. Many of School B's students are deficient in English and therefore, enroll in courses such as Spanish Math I or Spanish Math II.

The majority of students at School B are not college oriented. Most will join the work force upon graduation. There are not many high-level math or science courses, and relatively few students enroll in those that do exist. Guidance counselors suggest that the reason for this is that many college-bound students who live in the city attend private and parochial schools. Since so few students in this school are college-bound, many pursue what appear to be vocational programs within this school.

School B is the only school where a "leak" of females from math courses appeared. While Algebra I consisted of 56% females, females in geometry dropped to 51% of the class. By Algebra II, females made up only 47% of the enrollment. The only high-level math class offered is Advanced Math in which 9 males and 7 females enrolled. In addition, one young man studied Calculus on an independent basis with a faculty member.

Young women dominated Physical Science with 57% of the enrollment, Biology with 59% of the enrollment, and Chemistry

with 56%. Only two high-level science classes are available to students at School B. The Advanced Biology class consisted of 54% young women. As in School A, young men outnumbered young women in Physics, 14 to 4. In addition, one young man studied Chemistry II independently under the direction of a faculty member.

At School B, young women received higher marks in all math and science courses than did young men. Young women received 57% (62) of the A's and 57% (123) of the B's given in math and science, whereas young men received 43% (46) of the A's and 43% (92) of the B's. Males and females received almost the same number of C's with females receiving 51% (131) and males receiving 49% (127). The failure rate was also similar with females receiving 51% (46) of all failing grades and males receiving 49% (44).

School C

School C is located outside of a large city. It serves as the vocational/technical school for four very different communities. As a result the student population of School C is socio-economically and culturally mixed. In addition, students from eight other communities were included in last year's senior class due to the fact that School C's thirteen vocational programs include several programs not offered at any other vocational/technical high school in the state. The class of 1985 was comprised of 153 students, 103 (67%) males and 50 (33%) females. Due to the large disparity in the number of males and

females attending School C, percentages of that gender in the class as well as actual numbers are reported.

As a vocational/technical high school, School C is primarily concerned with preparing students for their chosen vocations. Since none of the vocational programs offered require high-level math or science courses, these courses are not a priority for the vast majority of students at School C. Trigonometry is the only advanced senior math course offered at School C. Its enrollment included six females (2% of the total number of females) and 9 males (2% of the total number of males). The two high-level senior science courses are Physics and Human Physiology. Although males outnumbered females in actual numbers, a greater percentage of females took part in both classes. Ten percent (28) of all senior females enrolled in Human Physiology compared with eight percent (46) of senior males. Three percent (9) of all females took Physics versus two percent (11) of all males.

Young women at the vocational/technical high school received slightly higher math and science grades than their male counterparts. Sixteen percent (16%) or 31 of the grades received by females were A's compared with 9% (37) received by males. B's were granted to approximately the same percentages of males and females. Thirty-three percent (33%) or 64 of the grades earned by young women were B's and 34% or 135 of the grades earned by young men were B's. Males received C's more frequently than females; 55% (219) of all male grades were C's compared with 49% (94) of all female grades.

School D

School D is located in a small town which is primarily a residential, bedroom community of the state's largest city. Middle to upper middle-class, the town is socio-economically and culturally homogeneous. The class of 1985 was composed of 217 students, 109 (50%) males and 108 (50%) females.

School D groups students in four basic academic areas. Approximately 15% of the students are considered "Honors" students and another 45% are "College Prep". These groups (approximately 60%) generally score one or more grade levels above the mean on standardized tests. About 35% of School D's students are considered "General" while the remaining 10% are designated "Developmental". The groups generally score one or more grade levels below the mean on standardized tests. Students at School D appear to be counseled in their educational choices. Approximately 60% of the students may be considered college-bound and 61% of the class of 1985 took the SAT's, one indication of proper guidance.

The females in last year's senior class at School D took more high-level math and science courses than their male counterparts. In upper-level math courses taken during the senoir year, females outnumbered males 60 to 49. Fifteen females and 13 males enrolled in Calculus while 45 females and 36 males took Advanced Math. In advanced science courses taken during the senior year, the figures were similar, with 55 females enrolling versus 40 males. Twelve females took Chemistry II compared to five males. In Human Physiology, female students outnumbered males 31 to 9.

Only in Physics did the 26 males enrolled outnumber the 12 females. There is no significant difference between the mean number of semesters of math and science taken by the two genders: males took 12.697; females took 12.703 (p= .98).

Moreover, female students at School D received higher marks than male students for their math and science courses. Females received 70% (140) of the A's given in math and science courses, whereas males received 30% (59) of the A's. Female students received 54% (266) of the B's given, while their male counterparts received 46% (223). The number of females receiving C's for their work in math and science courses was substantially less than the number of males. Forty-one percent (41%, 300) of the C's were received by females, compared with 59% (423) by males.

Female students at School D enrolled more frequently in honors math and honors science courses than did male students. During their four years in high school, females in the class of 1985 participated in honors courses 149 times versus 99 times for males.

Schools E and F

Schools E and F are located in one of the larger cities of the state. Its 71,000 residents belong to a wide range of socio-economic, ethnic, and cultural groups. Many are recent immigrants to the United States. As in other metropolitan areas, many residents who are financially able send their children to private and parochial schools. School E (164 students in the class of 1985) is somewhat smaller than School F (261 individuals

in the class of 1985), but their student composition are basically the same.

School E's 164 1985 seniors included 83 (51%) males and 81 (49%) females. Males and females at School E enrolled in high-level math and science courses in similar numbers. In upper-level math courses a total of 15 males and 13 females enrolled. Only three students (two males and one female) took Calculus. The 25 remaining students, 13 males and 12 females, took Advanced Math. High-level science courses were elected by 82 students, 39 males and 43 females. Four males and seven females enrolled in Biology II. Physics was chosen by 20 males and 16 females. Fifteen (15) males and 20 females took Human Physiology.

School E's female students, like young women elsewhere, received higher grades than young men in math and science course work. Females received 60% (50) of the A's compared to 40% (33) received by males. The number of B's was equally distributed between males (128, 50%) and females (127, 50%). Males received considerably more C's than females, 194 (56%) to 155 (44%).

The 261 members of School F's class of 1985 included 115 males (44%) and 146 females (56%). As at School E, similar numbers of young men and young women enrolled in high-level math and science courses. In upper-level math classes a total of 69 students (34 males and 35 females) enrolled. Males (22) outnumbered females (15) in Trigonometry, a one-semester mini-course. Likewise, there were two more males than females in Calculus with eight males and six females enrolled. In Advanced Math, however, the 14 females far outnumbered the four males enrolled. Females were more likely to take high-level science

courses than their male counterparts. Of last year's graduates, 77 females and 69 males (146 in all) enrolled in upper-level science courses. Chemistry II's enrollment was divided equally between males (5) and females (5). More young men than young women took Physics with 39 males and 26 females enrolled. Forty-six (46) females took Human Physiology compared with 25 males.

As at all the other schools surveyed, female students at School F received higher marks in math and science classes than their male classmates. Fifty-five percent (55%) or 82 of the A's went to females, while 45% (66) went to males. Young women received 56% (251) of the B's compared to 44% (197) received by males. Females received 53% (329) of the C's while males received 47% (287) of them.

In sum, the study indicates that male and female students in Rhode Island's public high schools, especially those who are college-bound, take equal amounts of math and science. While a "leak" of students does occur between the introductory courses and the more advanced levels, the leak is not predominately of one gender. More males than females do take the general math courses which are non-college preparatory courses. We want to note that the preliminary analyses of course enrollment data collected to date in the second phase of the study which includes a larger sample of schools have corroborated these findings.

Discussion

If the following statement is true on a national basis,

> Males take more math and science courses than females. Even among students in the same academic track, a gender difference persists (Concerns, 1985),

then Rhode Island presents an anomoly. The study reveals that in Rhode Island males do not take more math and science courses than females. In many courses, more females enroll than males. Fewer students take higher level math and science courses, but the decrease in numbers is not predominated by one sex. This equity is especially apparent among college-bound students. From another view, however, the Rhode Island picture should not be surprising. In his major work on high schools, Sizer (1984) focuses on the gender-neutral character of schools:

> Young males and females are treated remarkably alike; schools' goals are the same for each gender. In execution, there are differences, as those pressing sex discrimination suits have made educators intensely aware...But it is revealing how much less discrimination there is in high schools than in other American institutions. For many young women, the most liberated hours of their week are in school (p. 79).

Still, we recognize that even where equity in enrollment exists, subtle and informal practices might be occurring which do affect or influence the actual learning, performance, or choice-making of students of each gender differently.

> Many schools formally endorse attitudes usually associated with males - competition, individualism, "toughing things out" - and give little support to attitudes more readily associated with females (Sizer, p. 39).

Both formally and informally, schools can be considered to have a male orientation (Tetreault & Schmuck, 1985). For example, when attention is focused on students, male students predominate (Lightfoot, 1983; Sadker & Sadker, 1985). Expectations for all students are defined in terms of education for male students (Tetreault & Schmuck, 1985). Competitive instructional strategies regularly employed in classrooms may work to the disadvantage of many female students who are uncomfortable with the behavior patterns required to succeed in such classroom settings (Concerns, 1985, p. 2; Peterson and Fennema, 1985). While the ratio of men to women teachers at the secondary level is relatively even (51 percent male, 49 percent female), 83 percent of the math and science teachers are male (Jones & Montenegro, 1982). Given this male orientation of schools, behaviors that occur within individual classrooms, the organization of classrooms, or the manner in which information is disseminated may, in reality, have a negative impact on the achievement or choices of females.

Some of the data from this study, does, however, give us an indication of the impact of classroom practices, organization, and information dissemination on student learning in Rhode Island. Whatever the practices or attitudes, females in this state are receiving better grades than their male counterparts. Previous studies correlating achievement, affect, cognitive ability, and gender indicated that, while females enjoyed science more, they appeared to have lower cognitive ability in the math and science areas (Steinkamp and Maehr, 1983). While grades reflect a variety of influences including achievement, affect,

and ability, as well as teacher expectations, the results of our study indicate that gender is not a factor in this state's grading practices for high school math and science courses unless it were to have falsely inflated female grades. If grades are an accurate indicator of what a student has learned from a class, many females learn as much if not more than male classmates in their math and science classes.

In addition to grades, another possible source of information about what a student has learned in high school classes is students' scores on the SAT's. These scores for Rhode Island males and females in the math section do not support the study results since female scores are nearly fifty points lower than male scores in Rhode Island (College Board Scores, 1985). In 1985, the mean score of males in Rhode Island was 491; the mean score of females was 443. To some degree these lower scores are not unusual because both regionally and nationally female scores on the SAT-M are lower. In 1985 in New England, the mean male score was 496; the mean female score was 452. Nationally on the SAT-M, the male mean was 499; the female mean was 452. Several reasons have been offered to explain the discrepancy on the national level. One reason offered is that more females take the test than do males (in 1985, 51.7 percent of those who took the SAT-M in the nation were female). Another explanation suggests that since females' achievement in mathematics is negatively related to engagement in competitive mathematics activities (Peterson & Fennema, 1985), and since the SAT-M might be seen as a competive activity by many females, they do not achieve to their potential. Certainly, if females are not

as prepared by having taken fewer math and science courses than their male counterparts, as documented by the various studies cited earlier in this paper, one could expect that the SAT-M for young women in Rhode Island would be measureably higher than the mean scores of females in the nation and might be closer to the mean of males in the same state. They are not; rather they are significantly lower than the SAT-M mean of both Rhode Island males and of females in the nation (College Board Scores, 1985).

This information on low SAT-M scores received by Rhode Island females, in light of the course enrollment and grades received results from this study, raises several questions:

- Do math and science teachers in this state inflate the grades of young women?
- Are the instructional strategies used by math and science teachers in Rhode Island those which encourage female learning while not hindering male learning?
- What or how much math and science do female students learn in Rhode Island public high schools?
- Why are the grades high and scores low?

Just as many factors contribute to the grade a student may receive, many factors influence what a student might learn or achieve. First, of course, is the opportunity to learn. Enrollment figures for Rhode Island appear to indicate that females and males have equal opportunity to learn. From the SAT-M data, a critic could infer either that course content in the state is inadequate compared to the content of math and science courses in high schools across the nation, or that actions of teachers and information dissemination strategies of teachers during instruction do not prepare females to perform on the SAT-M. The Rhode Island Commissioner of Education points out, however, that

his state ranks fifth among the twenty-two SAT states in the percentage of students who take the test, sixty percent. He commented that this high percentage is probably a reflection of a "New England mentality" that traditionally encourages the test. It may actually lower the state's ranking in the raw scoring because even below average students take the test (Earhart, 1985).

Our observations and discussions with guidance counselors during data collection corroborate the Commissioner's remarks. As we stated earlier, we began to collect SAT scores, but discontinued once we saw that collection across schools could not be consistent. In the first two schools, however, we noted that many students whose grades and course work would not have prepared them for taking these tests did take them. The counselors at these schools commented that nearly all parents encouraged their children to take the exam.

Counselors at all of the schools made several other observations we feel are relevant to the study. None were surprised that females took at least as many math and science courses as males. In fact, they were surprised that we needed to do a study to document this practice and found it difficult to believe that studies conducted in other states had demonstrated the opposite. Each described a clear college-bound group which "always loses a few of both sexes over the years" and a small group of honor students, equally male and female, who take the Calculus sequence all the way through. They offered a variety of suggestions as to why this apparently atypical equity exists in Rhode Island.

Counselors at three schools reasoned that perhaps young women in their schools took math because their math departments had more female teachers than males: "They are great teachers, too, so the girls have good role models." One believed that the private schools "skimmed off the cream" from her school's student population. Since most of the students who attend private schools in that community are males, she expected that the number of males in top level math and science courses would increase if we had included private schools in our study. State figures do show that more males attend private schools in this state than females; one cannot predict if they are the "cream" or not. Another counselor suggested that the state's unique character played a role:

> We are largely a blue collar state, you know - with lots of second generation immigrants. A father knows his son can always get a job in the trades, but he worries about his daughter's future. So he pushes her to be prepared for college. Maybe that is why girls in this state take more math and science than boys.

Whatever the reasons offered to explain or meanings one might attach to the figures revealed in this study, a pattern has surfaced that demonstrates equity for females in math and science enrollments in Rhode Island public high schools. While math and science may be a "critical filter" (Sells, 1978), the filters work similarly on male and female students in Rhode Island. The existence of the pattern in one state does have several implications.

First, if this pattern is idiosyncratic to Rhode Island public schools, the effects and influences that have supported

its development should be identified and encouraged. Students should be interviewed in an effort to determine what factors influenced their choices. Classes should be observed to see whether attitudes or instructional strategies are especially favorable to female learning.

It is also possible that female enrollment patterns have not increased to equal males; rather, the apparent equity may be the result of fewer males taking full math and science sequences than before. If that is the case, the state's schools must heed the reports that stress the need for more complete math and science preparation for students of both sexes.

The pattern may, on the other hand, be indicative of an emerging trend in schools across the nation. If this trend is present elsewhere, and equity between genders in course selection and grades is no longer a pressing issue in high school preparation, then we need to look closely at other aspects of the total picture. For example, will this new group of "prepared" females succeed in more of the scientific or technological careers than their predecessors? A 1984 study by the Rockefeller Foundation, Who Will Do Science? (Berryman) substantiates that women are underrepresented in the scientific disciplines. Will these young women who have taken math and science have the actual choices to enter previously male-dominated fields and will they act on these choices? Since the pattern of course work for female students in high school may be changing, female job or career patterns may also be changing, or open to change, in the near future.

APPENDIX

TABLE 1: Math Courses Taken in High School by the Class of 1985

TABLE 2: Science Courses Taken in High School by the Class of 1985

TABLE 3: Math and Science Grades Received by Students at Six Rhode Island High Schools

TABLE 1

MATH COURSES TAKEN IN HIGH SCHOOL BY THE CLASS OF 1985

Course	MALE N=556			FEMALE N=555			TOTALS N=1111	
	N	% OF STUDENTS IN THIS COURSE WHO ARE MALE	% OF ALL MALES WHO TAKE THIS COURSE	N	% OF STUDENTS IN THIS COURSE WHO ARE FEMALE	% OF ALL FEMALES WHO TAKE THIS COURSE	N	% OF TOTAL SAMPLE WHO TOOK THIS COURSE
General Math I	166	59	30	117	41	21	283	26
General Math II	68	57	12	52	43	9	120	11
Pre-Algebra*	68	58	12	49	42	9	117	11
Algebra I*	352	48	63	387	52	70	739	67
Geometry	285	48	51	314	52	57	599	54
Algebra II	248	46	45	295	54	53	543	49
Advanced Math	100	47	18	114	53	21	214	19
Calculus	29	51	5	28	49	5	57	5
Business Math	120	49	22	124	51	22	244	22

* - Figures for Pre-Algebra and Algebra I may show less than those who actually took either or both courses during grade 8 and/or grade 9 since records for these grades were sometimes unavailable or incomplete.

The following courses are not listed because so few students were enrolled: Pre-Calculus, Developmental Math I and II, Spanish Math I and II, Portuguese Math I and II, Shop Math, Technical Math, Finite Math, Consumer Math and Cereer Math.

TABLE 2

SCIENCE COURSES TAKEN IN HIGH SCHOOL BY THE CLASS OF 1985

	MALE N=556			FEMALE N=555			TOTALS N=1111	
Course	N	% OF STUDENTS IN THIS COURSE WHO ARE MALE	% OF ALL MALES WHO TAKE THIS COURSE	N	% OF STUDENTS IN THIS COURSE WHO ARE FEMALE	% OF ALL FEMALES WHO TAKE THIS COURSE	N	% OF TOTAL SAMPLE WHO TOOK THIS COURSE
General Phys. Sci.	420	54	76	357	46	64	777	70
Biology I	433	49	78	444	51	80	877	79
Chemistry I	161	43	29	213	57	38	374	34
Physics	124	63	22	73	37	13	197	18
Human Physiology	106	43	19	138	57	25	244	22
Biology II	14	39	3	22	61	4	36	3
Chemistry II	17	43	3	23	57	4	40	3
Computer Science	54	52	10	50	48	9	104	9
Computer Programming	98	52	18	91	48	16	189	17

The following courses are not listed because so few students were enrolled: Earth Science, Basic Biology, Human Body, Spanish Science, Portuguese Science, and Advanced Computer Programming.

TABLE 3

MATH AND SCIENCE GRADES RECEIVED BY STUDENTS AT SIX RHODE ISLAND HIGH SCHOOLS*

Grade	MALE N=556			FEMALE N=555			TOTALS N=1111	
	N	% OF ALL RECEIVING THIS GRADE WHO ARE MALE	% OF ALL MALES WHO RECEIVE THIS GRADE	N	% OF ALL RECEIVING THIS GRADE WHO ARE FEMALE	% OF ALL FEMALES WHO RECEIVE THIS GRADE	N	% OF STUDENTS WHO RECEIVE THIS GRADE
A (90-100)	305	40	10	460	60	16	765	13
B (80-89)	972	48	33	1066	52	36	2038	34
C (70-79)	1447	54	48	1220	46	41	2667	45

Among the students sampled the mean of all math and science grades received by males was 2.36; the mean of all math and sience grades received by females was 2.51. The difference between these two figures is statistically significant (p=.004).

* - Grades below 70 were not recorded due to differences in grading policies among the districts sampled.

REFERENCES

Armstrong, J. Achievement and participation of women in mathematics: An overview. Denver, CO: Education Commission of the States, March, 1980.

Berryman, S. Who will do science? New York: Rockefeller Foundation, 1984.

Carpenter, T., Corbitt, M., Kepner, H., Lindquist, M., and Reys, R. Results from the Second Mathematics Assessmemt of the National Assessment of Educational Progress. Reston, VA: National Council of Teachers of Mathematics, 1981.

Chief State School Officers Resource Center in Educational Equity. Concerns. XVI, October, 1985.

College Board Scores, 1985: A Reference Guide. Waltham, MA: College Board New England Regional Office.

Earhart, T. Providence Journal Bulletin, February 21, 1986, p. B-7.

Fennema, E., and Sherman, J. Women and research perspectives for change. Washington, DC: National Institute of Education, 1977.

Fox, L., Brody, L., and Tobin, D. (Eds.). Woman and the mathematical mystique. Baltimore: Johns Hopkins University Press, 1980.

Jones, E. and Montenegro, X. Recent Trends in the Representation of Women and Minorities in School Administration and Problems in Documentation. Arlington, VA: American Association of School Administrators, 1982.

Lightfoot, S. The Good High School. New York: Basic Books, 1983.

National Commission on Excellence in Education. A Nation at Risk: The Imperative for Educational Reform. Washington, DC: Government Printing Office, 1983.

Reis, H. A longitudinal study of quantitative-verbal interests. Unpublished paper, University of Rochester, 1980.

Sadker, M. and D. "Sexism in the Classroom", Vocational Education Journal, October, 1985, pp. 30-32.

Sells, L. "Mathematics - A critical filter," The Science Teacher, V. 43, #2, February 1978.

Sherman, J. Sex related cognitive differences. Springfield, IL: Charles C. Thomas, 1978.

Sizer, T. Horace's Compromise. Boston: Houghton-Mifflin, 1984.

Steinkamp, M. and Maehr, M. "Affect, ability, and science achievement: A quantitive syntheses of correlational research," Review of Educational Research, V. 53, #3, Fall, 1983, pp. 369-396.

Tetreault, M.K. and Schmuck, P. "Equity, Educational Reform, and Gender," Issues in Education, Vol. III, No. 1, Summer, 1985, pp. 45-67.